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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte ANDERS LARSSON, KLAS ALLMER, and PER ANDERSSON

Appeal No. 2009-014314
Application 09/674,457
Technology Center 1700

Decided: May 28, 2010

Before BRADLEY R. GARRIS, CHUNG K. PAK, and MARK NAGUMO, *Administrative Patent Judges*.

PAK, *Administrative Patent Judge*.

DECISION ON APPEAL

Appellants appeal under 35 U.S.C. § 134(a) from the Examiner's refusal to allow claims 43 through 49, all of the claims pending in the above-

identified application. *See* page 4 of the Amended Appeal Brief ("App Br.") filed October 4, 2006. We have jurisdiction under 35 U.S.C. §§ 6 and 134.[1]

STATEMENT OF THE CASE

The subject matter on appeal is directed to a method of using "microfluidic devices which may be used for a variety of biological processes, e.g., screening putative biologically active molecules against cell cultures or separating biological materials" (Spec. 1, ll. 3-6 and claim 43). Details of the appealed subject matter are recited in representative claims 43, 46, 47, 48, and 49[2] reproduced from the Claims Appendix to the Appeal Brief as shown below:

> 43. A method for controlling flow of a liquid in a microfluidic device comprising the steps of:
>
> adding liquid to an inlet of a circular microfluidic device that is adapted for rotation about its axis, wherein said device comprises two substrates between which there are predetermined pathways for liquid flow, and wherein the inlet is capable of handling less than about 500nl of a liquid sample and the liquid flows down the hydrophilic pathway until the liquid reaches a hydrophobic section or valve in the pathway preventing the flow of liquid; and

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[1] Although Appellants appeal from the Examiner's non-final Office action dated March 9, 2006, we have jurisdiction pursuant to 35 U.S.C. §§ 6 and 134 since the claims have been twice presented and rejected.

[2] Appellants separately argue the limitations recited in claims 43, 46, 47, 48, and 49 (App. Br. 5-14). Therefore, for purposes of this appeal, we select claims 43, 46, 47, 48, and 49 and decide the propriety of the Examiner's §§ 102(b) and 103(a) rejections set forth in the Answer based on these claims alone. *See* 37 C.F.R. § 41.37(c)(1)(vii) ("When multiple claims subject to the same ground of rejection are argued as a group by appellant, the Board may select a single claim from the group of claims that are argued together to decide the appeal with respect to the group of claims as to the ground of rejection on the basis of the selected claim alone.").

applying sufficient energy to the liquid allowing it to pass the valve and continue to flow down the pathway.

46. The method of claim 43, wherein the liquid has a surface tension > 18 mNm^{-1}.

47. The method of claim 43, wherein the liquid is an aqueous solution or suspension having a surface tension > 50 mNm^{-1}.

48. The method of claim 43, wherein the liquid sample comprises reagents.

49. The method of claim 43, wherein the liquid sample is between 1 to 10nl.

As evidence of unpatentability of the claimed subject matter, the Examiner relies on the following prior art references at page 3 of the Answer. ("Ans.") dated February 4, 2008:

Kellogg '248	6,143,248	Nov. 7, 2000 (Filing date Aug. 12, 1997)
Kellogg '019	WO 98/07019	Feb. 19, 1998

Appellants request review of the following grounds of rejection set forth in the Answer:

1) Claims 43 through 47 under 35 U.S.C. § 102(e) or (a) as anticipated by the disclosure of Kellogg '248 or Kellogg '019; and

2) Claims 48 and 49 under 35 U.S.C. § 103(a) as unpatentable over the disclosure of Kellogg '248 or Kellogg '019 (App. Br. 5).

Appellants contend that neither Kellogg '248 nor Kellogg '019 describes "a method of controlling flow of a liquid by using a hydrophobic section with a hydrophilic pathway in a microfluidic device" as required by

claim 43 (App. Br. 7 and 11 and the Reply Brief ("Reply Br.") filed February 28, 2007, 2-4 and 6). According to Appellants:

> Although surface modification is mentioned in the context [of] controlling fluid flow, Kellogg focuses and provides working examples [of] surface modification combination with geometry changes.

(App. Br. 7 and 11). Appellants also contend that neither Kellogg '248 nor Kellogg '019 teaches the limitation "the inlet …capable of handling less than about 500nl of a liquid sample" recited in claim 43 (App. Br. 8 and 12 and Reply Br. 5-6). Appellants further contend that the Examiner does not discuss the teachings of Kellogg '248 and '019 which are directed to the liquid surface tension of greater than 18 or 50 mNm^{-1} recited in claims 46 and 47 (App. Br. 9 and 13). Finally, Appellants contend that neither Kellogg '248 nor Kellogg '019 would have prompted one of ordinary skill in the art to employ a liquid sample containing reagents as recited in claim 48 or a liquid sample in an amount "between 1 to 10 nl" as recited in claim 49 (App. Br. 13-14 and Reply Br. 6-7).

ISSUES AND CONCLUSIONS

With respect to claims 43 through 45, the dispositive question is: Does Kellogg '248 or '019 teach using a hydrophobic section with a hydrophilic pathway and an inlet capable of handling less than about 500nl of a liquid sample in its microfluidic device within the meaning of 35 U.S.C. § 102(e) or (a)? On this record, we answer this question in the affirmative.

With respect to claims 46 and 47, the dispositive question is: Does Kellogg '248 or '019 teach employing a liquid sample having a surface tension of greater than 18 or 50 mNm^{-1} in its microfluidic device within the

meaning of 35 U.S.C. § 102(e) or (a)? On this record, we answer this question in the affirmative.

With respect to claims 48 and 49, the dispositive question is: Would Kellogg '248 or Kellogg '019 have prompted one of ordinary skill in the art to employ a liquid sample containing reagents as recited in claim 48 or a liquid sample in an amount "between 1 to 10 nl" as recited in claim 49 within the meaning of 35 U.S.C. § 103(a)? On this record, we answer this question in the affirmative.

RELEVANT FACTUAL FINDINGS

The following relevant factual findings are supported by at least a preponderance of the evidence.

1. Appellants do not question that Kellogg '248 and '019 individually teach "[a] method for controlling flow of a liquid in a microfluidic device comprising the steps of : adding liquid to an inlet of a circular microfluidic device that is adapted for rotation about its axis, where said device comprises two substrates between which there are predetermined pathways for liquid flow" as recited in claim 43. (*See* App. Br. 5-14; *see also* Kellogg '248, col. 1, ll. 15-22, and Kellogg '019, p. 1, ll. 10-15).

2. Appellants also do not dispute the Examiner's findings at pages 4 and 5 of the Answer that Kellogg '248 and Kellogg '019 individually teach that:

> In a fourth embodiment of the invention is provided a centrifugal rotor or Microsystems platform for providing centripetally-motivated fluid micromanipulation, wherein a volume of a fluid sample, most preferably comprising a biological sample, in a first fluid chamber of the rotor or platform is delivered in a stream of droplets into a second fluid chamber on the rotor or platform. In such embodiments of the invention, said rotor or platform is a rotatable platform,

comprising a substrate having a first flat, planar surface and a second flat, planar surface opposite thereto, each surface comprising a center about which the platform is rotated. In said centrifugal rotor or microplatform is provided a first surface that comprises the following components in combination:

. . . 1. An *entry port* comprising a depression in the first surface having a volumetric capacity of about 1 to about 150 .mu.L and that is accessible to an operator for application of a fluid sample, most preferably a fluid comprising a biological sample. The entry port is fluidly connected with

. . . 2. A *first microchannel* which defines a cross-sectional area of about 0.02 mm to about 1 mm in diameter that extends radially from the center of the platform and defines a first end proximally arrayed towards the center of the platform and is fluidly connected with the entry port, and a second end distally arrayed from the center of the platform. The first microchannel is further fluidly connected with

. . . 3. A *first fluid chamber* having a depth in the surface of the platform equal to or greater than the first microchannel and positioned radially more distant from the center of the platform than the entry port. Rotation of the platform at a first rotational speed motivates displacement of the fluid in the entry port through the first microchannel and into the first fluid chamber.

. . . The platform further comprises:

. . . 4. *A second microchannel*, wherein the second microchannel extends radially from the center of the platform and defines a first end proximally arrayed towards the center of the platform and a second end distally arrayed from the center of the platform. The second microchannel is fluidly connected with the first fluid chamber at the first end of the microchannel and the second microchannel is fluidly connected at the second end of the microchannel with

> …5. A *second fluid chamber* having a depth in the surface of the platform equal to or greater than the second microchannel and positioned radially more distant from the center of the platform than the first fluid chamber.
>
> . . . *The second end of the second microchannel comprises a surface that is non-wetting* or alternatively the second end of the second microchannel defines an opening into the second fluid reservoir. Rotation of the platform at the first rotation speed does not motivate flow of the displacement fluid through the second microchannel. *Rotation of the platform at a second rotational speed that is greater than the first rotational speed motivates flow of the fluid from the first fluid chamber, through the second microchannel and into the second fluid chamber.* As a consequence of the properties of the second end of the second microchannel, flow of the fluid into the second fluid chamber comprises a stream of droplets from about 0.1 to about 10 μL in volume. In addition, each of the microchannels and the fluid chambers also comprise air displacement channels whereby air displaced by fluid movement is vented to the surface of the platform. [*Compare* Ans. 4-5 *with* App. Br. 5-15 and Reply Br. 1-7; *see also* Kellogg '248, col. 10, l. 57 to col. 11, l. 54 and Kellogg '019, p. 15, l. 22 to p. 17, l. 2 (emphasis in original)]

3. Kellogg '248 and '019 individually teach that:

> The invention relates to the methods and apparatus for controlling fluid flow in microfluidic systems. In, particular, the invention provides *microvalves* for controlling fluid flow from microreservoirs into transfer channels using capillary valving mechanisms. The capillary *valving mechanisms* of the invention are based on *changes in cross-sectional area and geometry* of orifices, reservoirs and microchannels and *surface treatment* of reservoirs and *channels* [Kellogg '248, col. 1, ll. 15-22 and Kellogg '019, p. 1, ll. 10-15 (emphasis added)].

4. Kellogg '248 and '019 individually teach that:

> For the purposes of this invention, the terms "capillary", "microcapillary" and "microchannel" will be understood to be interchangeable and to be constructed of either wetting or non-wetting materials where appropriate. [*See* Kellogg '248, col. 13, ll. 60-63 and Kellogg '019, p. 20, ll. 5-7].

5. Kellogg '248 and '019 individually teach that:

> By varying the intersection shapes, materials, and cross-sectional areas of the components of the microsystems platform of the invention, "valve[s]" are fashioned that require the application of a particular pressure on the fluid to induce fluid flow. This pressure is applied in the disks of the invention by rotation of the disk [Kellogg '248, col. 15, ll. 32-38 and Kellogg '019, p. 22, ll. 16-20].

6. Kellogg '248 and '019 individually teach that:

> All fluids can be characterized by interactions with solid substrate and gasses. These interactions are further characterized by *interfacial tension, or the energy per unit area at the interface of the fluid with another substrate* . . . . Under "wetting" conditions, the liquid and solid experience mutual attraction. In such cases, liquids may flow from a larger reservoir into a smaller, more narrow tube, in order to maximize the area of the solid/liquid interface. Flow through the tube is inhibited if the tube opens to a sufficiently large diameter that the area of solid/liquid contact would decrease by additional flow. . . . *Flow can be initiated into a non-wettable tube by applying pressure to the fluid.* If a fluid encounters a constriction in the tube, capillarity requires even the greater pressure to be applied. . . .
>
> Physical surface features of fluid containing solids are known to affect the behavior of fluids . . . . By the proper design of surface features and selection of materials, structures can be designed to allow fluid flow only when sufficient pressure is applied to the liquid. This force can be . . . preferably, centripetal force due to rotation of microfabricated

> structures on centrifugal rotors and microplatforms provided as described herein [Kellogg '248, col. 16, ll. 33-64 and Kellogg '019, p. 24, ll. 2-23) (emphasis added)].

7. Appellants do not dispute the Examiner's finding that Kellogg '248 and '019 teach that the fluids employed are water and blood. (*Compare* Ans. 11 w*ith* App. Br. 9 and 13 and Reply Br. 1-7; *see, e.g.,* Kellogg '248, col. 27, ll. 4-23 and 59-60).

8. Appellants do not dispute that water and blood have surface tensions of 72 mN/meter and 56 mN/meter, respectively. (*Compare* Ans. 11 *with* App. Br. 9 and 13 and Reply Br. 1-7; *see, e.g.,* Kellogg '248, col. 27, ll. 63-65).

9. Appellants do not dispute the Examiner's finding that Kellogg '248 and '019 teach combining a liquid sample with a reagent in the reservoir of the device. (*Compare* Ans. 6 and 8 *with* App. Br. 14 and Reply Br. 6).

10. Kellogg '248 and '019 also teach adding reagents to a liquid sample, i.e. a blood (Kellogg '248, col. 27, ll. 8-23 and Kellogg '019, p. 39, ll. 18-29).

11. Appellants do not dispute the Examiner's finding that one of ordinary skill in the art interested in conserving a sample material would have used a small amount of the sample material. (*Compare* Ans. 6 *with* App. Br. 14 and Reply Br. 6).

ANALYSIS AND PRINCIPLES OF LAW

I. CLAIMS 43 THROUGH 45

There is no dispute that Kellogg '248 and '019 individually teach "[a] method for controlling flow of a liquid in a microfluidic device comprising

the steps of: adding liquid to an inlet of a circular microfluidic device that is adapted for rotation about its axis, where said device comprises two substrates between which there are predetermined pathways for liquid flow" as recited in claim 43. Nor is there any dispute that Kellogg '248 and Kellogg '019 individually teach providing an entry port capable of handling a volume capacity of about 1 to about 150 μl of a liquid sample and flowing the liquid down the predetermined pathway, such as a first microchannel and/or a second microchannel, with the second end of the second microchannel comprising a surface that is non-wetting corresponding to the claimed hydrophobic section, or alternatively defining an opening into a second fluid reservoir.

Although Kellogg '248 and '019 do not mention that their predetermined pathway, i.e., the first microchannel and/or a portion of the second microchannel, is hydrophilic as required by claim 43, they clearly teach that *only* the second end of the second microchannel is made of the non-wetting surface (hydrophobic surface) or alternatively the opening into the second reservoir. Kellogg '248 and '019 also teach that such a non-wetting end section (the hydrophobic section) or opening into the second fluid reservoir prevents or inhibits the further flow of liquid in the microchannel absent the application of sufficient energy on the liquid via a sufficient rotational speed of the platform. According to Kellogg '248 and '019, this hydrophobic section or opening is used as a valve in the microchannel system. Since there are only two possible materials, i.e., wetting and non-wetting materials, used in constructing the microchannels and since only the second end of the second microchannel is taught to be a non-wetting surface useful as a valve, the remaining portion of the second

microchannel taught by Kellogg '248 and '019 in their forth embodiment must necessarily be or is impliedly the one other than the non-wetting surface, i.e., a wetting surface (hydrophilic surface). *In re Robertson*, 169 F.3d 743, 745 (Fed. Cir. 1999) (Inherent anticipation requires that the missing descriptive material be "'necessarily present'" in the prior art.); *see also In re Preda*, 401 F.2d 825, 826-27 (CCPA 1968) (In determining whether a claim is anticipated by a reference, "it is proper to take into account not only specific teachings of the reference but also the inferences which one skilled in the art would reasonably be expected to draw therefrom."). This interpretation is consistent with the subsequent passages at column 16, lines 33 to 64, of Kellogg '248 and at page 24, lines 2 to 23, of Kellogg '019, which further state that the liquid flowing down a hydrophilic pathway can be inhibited by a large opening or a non-wetting surface. In any event, we determine that the selection of one, i.e., a wetting material (hydrophilic material), from the two possible construction materials taught by Kellogg '248 and '019 for the purpose of constructing the rest of the microchannel (predetermined pathway) would have been readily envisaged by one of ordinary skill in the art within the meaning of 35 U.S.C. § 102. *In re Schaumann*, 572 F.2d 312, 314-315 (CCPA 1978); *In re Petering*, 301 F.2d 676, 681 (CCPA 1962).

As also argued by Appellants at pages 8, 12, and 13 of the Appeal Brief, Kellogg '248 and '019 also do not specifically mention their inlet port in terms of the claimed functional limitation, i.e., as capable of handling less than about 500 nl of a liquid sample. However, the inlet ports taught by Kellogg '248 and '019 are large enough to handle or receive a volume of about 1 to about 150 μl (about 1,000 nl to about 150,000 nl) of a liquid

sample. Thus, it is reasonable for the Examiner to believe that such inlet ports are also capable of handling or receiving a smaller volume of about 500 nl of a liquid sample. Yet, on this record, Appellants have not shown that the inlet ports capable of handling or receiving about 1,000 nl of a liquid sample taught by Kellogg '248 and '019 are incapable of handling or receiving about 500 nl of a liquid sample. As our reviewing court stated in *In re Schreiber*, 128 F.3d 1473, 1478 (Fed. Cir. 1997):

> A patent applicant is free to recite features of an apparatus either structurally or functionally. *See In re Swinehart*, 58 C.C.P.A. 1027, 439 F.2d 210, 212, 169 USPQ 226, 228 (CCPA 1971) ("[T]here is nothing intrinsically wrong with [defining something by what it does rather than what it is] in drafting patent claims."). Yet, choosing to define an element functionally, i.e., by what it does, carries with it *a risk*. As our predecessor court stated in *Swinehart*, 439 F.2d at 213, 169 USPQ at 228:
>
>> where the Patent Office has reason to believe that a functional limitation asserted to be critical for establishing novelty in the claimed subject matter may, in fact, be an inherent characteristic of the prior art, it possesses the authority to require the applicant to prove that the subject matter shown to be in the prior art does not possess the characteristic relied on. [Emphasis added.]

Accordingly, based on the totality of the record, we determine that the preponderance of evidence weighs most heavily in favor of anticipation of the subject matter defined by claims 43 through 45 within the meaning of 35 U.S.C. § 102.

II. CLAIMS 46 AND 47

Appellants do not dispute the Examiner's finding at page 11 of the Answer that Kellogg '248 and '019 teach that the fluid employed are water and blood. Nor do Appellants dispute that water has a surface tensions of 72 mN/meter. Hence, we concur with the Examiner that Kellogg '248 and '019 teach an aqueous solution having a surface tension greater than 18 mN/meter as recited in claim 46 or having a surface tension greater than 50mN/meter as recited in claim 47.

Accordingly, based on the totality of the record, we determine that the preponderance of evidence weighs most heavily in favor of anticipation of the subject matter defined by claims 46 and 47 within the meaning of 35 U.S.C. § 102.

III. CLAIMS 48 AND 49

Claim 48 requires the presence of a reagent in the liquid sample but does not indicate when the reagent is introduced into the liquid sample. Appellants do not dispute the Examiner's finding that Kellogg '248 and '019 teach combining a liquid sample with a reagent in the reservoir of the device. We also note that Kellogg '248 and '019 teach adding a reagent to a liquid sample, such a blood, before introducing the mixture into the inlet port . Accordingly, we determine that Kellogg '248 and '019 teach the liquid sample containing a reagent as required by claim 48.

Accordingly, on this record, we determine that forming or using the liquid sample containing a reagent recited in claim 48 in the method taught by Kellogg '248 or '019 would have been obvious to one of ordinary skill in the art within the meaning of 35 U.S.C. § 103.

Claim 49 recites that "the liquid sample is between 1 to 10 nl." As indicated *supra*, the inlet ports taught by Kellogg '248 and '019 capable of handling or receiving a volume of 1000 nl of a liquid sample are reasonably expected to handle or receive a smaller volume of a liquid sample, e.g., 1 to 10 nl of a liquid sample as recited in claim 49. Appellants have not shown that the inlet ports capable of handling or receiving about 1,000 nl of a liquid sample taught by Kellogg '248 and '019 are incapable of handling or receiving about 10 nl of a liquid sample. Nor have Appellants disputed the Examiner's finding that one of ordinary skill in the art interested in conserving a sample material would have used a small amount of the sample material. Hence, we concur with the Examiner that one of ordinary skill in the art would have been led to employ a small amount of a liquid sample, such as those claimed, in the method taught by Kellogg '248 or '019, with a reasonable expectation of conserving the liquid sample used.

Accordingly, on this record, we determine that the employment of the volume of a liquid sample recited in claim 49 in the method taught by Kellogg '248 or '019 would have been obvious to one of ordinary skill in the art within the meaning of 35 U.S.C. § 103.

ORDER

In view of the foregoing, the decision of the Examiner is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a).

AFFIRMED

Ssl

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NAGUMO, *Administrative Patent Judge*, CONCURRING

In my view, the decision to AFFIRM the Examiner's rejections of claims 43-45 and 49 stands sufficiently and solely on the failure by Appellants to come forward with evidence of record demonstrating error in the Examiner's determination that the devices disclosed in the Kellogg references are capable of handling the smaller volumes of liquid samples recited in the claims.